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Fir Engraver Beetle

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The fir engraver, *Scolytus ventralis* Lec., is a native bark beetle which attacks most species of fir in the West and often causes heavy tree mortality. It is found from British Columbia south into Baja California and as far east as the Rocky Mountains (fig. 1). The fir engraver is the primary insect enemy of its three main host trees—white fir, grand fir, and red fir. It also attacks Douglas-fir, alpine fir, western hemlock, and Engelmann spruce.

In California alone the fir engraver is responsible for the death of an estimated 450 million board-feet of green timber each year. Under epidemic conditions losses are even greater. Epidemic infestations are fairly local in occurrence but are often very severe. In New Mexico, for example, some 37,000 trees were killed in 1954 on 6,000 acres of the Cibola National Forest.

Causes for these outbreaks are not well understood, but lowered resistance of the trees sometimes appears to be a contributing factor. The Cibola infestation coincided with a period of low rainfall. Several fir engraver outbreaks in California and southern Oregon have followed drought periods; others have taken place during periods of normal precipitation.

Evidence of Attack

Like most other bark beetles, the fir engraver causes damage by mining in the cambium of the tree. Attacks are first indicated by tiny holes in the bark, about three thirty-seconds of an inch in diameter, through which the beetles have bored into the cambium. Most often these entrance holes are located in the roughened bark around the junction of a branch and the trunk. Reddish-brown boring dust lodged in bark crevices and in cobwebs along the trunk may also be seen.

Later, girdled twigs and branches begin to fade as their nutrient and moisture supplies are disrupted by extension of beetle galleries. The appearance of this fading foilage, commonly called "flagging," is the first easily seen indication of a fir engraver infestation. Pitch tubes, often formed when bark beetles attack pines, are not produced on the firs. Streamers of clear pitch, however, often exude from the entrance holes and flow down the trunk for some distance.

Numerous attacks over the entire bole may girdle a tree in a single season; fading then becomes uniform throughout the crown (fig. 2). Lesser degrees of attack result in incomplete tree killing, either top

¹ Maintained by the Forest Service, U. S. Department of Agriculture, Berkeley, Calif., in cooperation with the University of California.

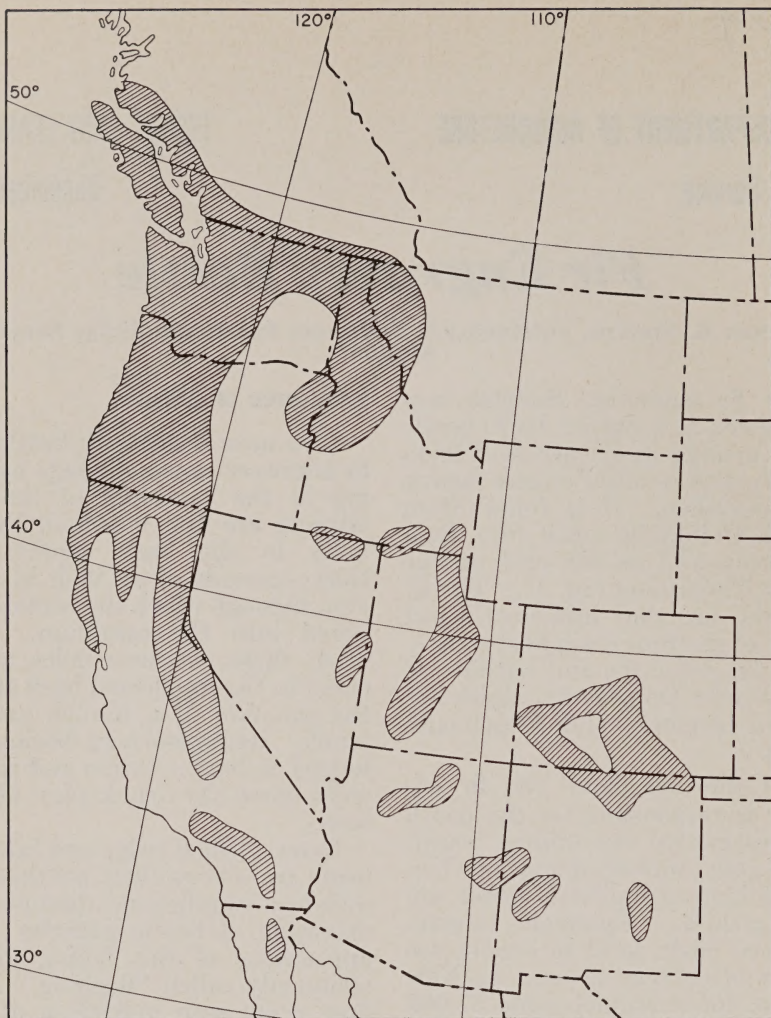


Figure 1.—Distribution of the fir engraver in western North America.

killing or destruction of scattered patches of cambium (fig. 3). Under these conditions, many trees recover. Patches of destroyed cambium heal over readily, and top-killed trees often send up new leaders.

The Insect

The adult fir engraver (fig. 4, *D*) is a small, shiny, black beetle about one-eighth inch in length, which

from the side is seen to have the abdomen incurved. This characteristic is typical of all members of the genus *Scolytus* and makes them easily recognizable. The eggs are minute, ovoid cylindrical, and pearly white in color. They hatch into tiny off-white larvae that pass through six molts before reaching the end of their development, at which time they are about adult size. Pupae are fragile and white;



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Figure 2.—Faded crowns in a white fir stand, a result of attacks by the fir engraver.

they, too, are about one-eighth of an inch long.

Life History and Habits

In the summer, newly matured adults emerge from infested trees and fly off in search of fresh host material. Time of emergence varies, probably depending primarily on temperature. Flight may occur any time from June through September, although most activity takes place during July and August.

Fir engravers readily attack standing green trees and will also attack and produce broods in freshly cut logs and recent windthrows. Attacks in individual living trees

appear to be more or less by chance, rather than because of an attraction by a tree characteristic.

When the fir engraver is present in normal numbers, death of mature trees is often hastened by the combined attacks of the engraver and the roundheaded fir borer, *Tetropium abietis* Fall. Under epidemic conditions, however, the fir engraver alone is generally responsible for the damage.

Attacks are made along the main trunk of the tree. The female beetle enters first, followed closely by the male. Mating takes place in a nuptial chamber and the male remains to help remove boring dust from the egg galleries.



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Figure 3.—Patch killing in white fir. Bark removed to show areas of dead cambium.

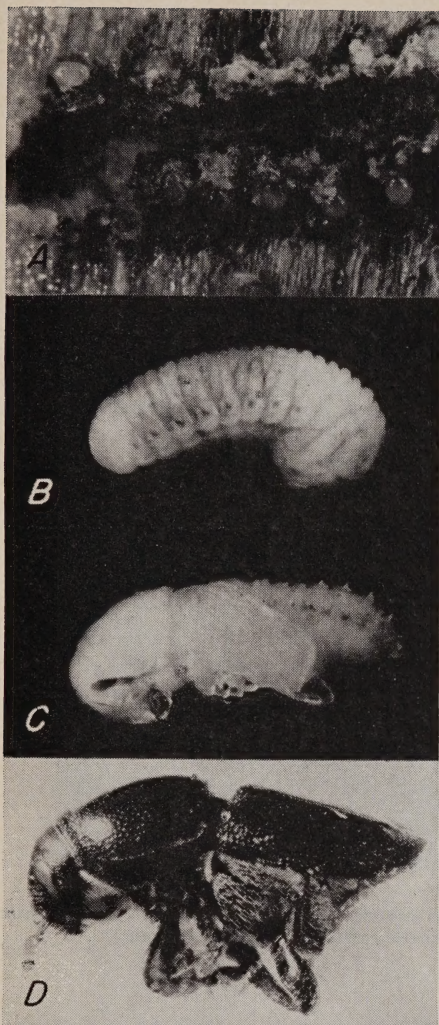
From the nuptial chamber the egg gallery is bored or tunneled out horizontally 2 to 3 inches in either direction (fig. 5). The female mines for awhile on one side of the chamber and then shifts to the other. Eggs are laid in tiny niches on both sides of the gallery. Each female lays between 100 and 300 eggs, and egg laying continues for 5 to 7 weeks.

Within 4 to 6 days after the egg gallery is started, a yellowish-brown discoloration of the surrounding area appears. This stain is caused by a fungus, *Trichosporium symbioticum* Wright, which is introduced by the beetles and spreads out in all directions from the gallery. It dries out the cam-

bium region and is thought to be an important factor in aiding brood development.

The eggs incubate for 9 to 14 days. After hatching, the tiny larvae begin tunneling their way out into the cambium. Their larval mines are generally parallel and extend at right angles to the egg gallery (fig. 5). Completion of the larval stage requires from 41 days in the southern limits of the beetle's range to 380 days in the northern limits.

Fir engravers overwinter as both larvae and adults, lying dormant during the winter and resuming activity in the spring. Larvae feed for a short period in the spring and then construct pupal cells at the



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Figure 4.—Life stages of the fir engraver: A, Eggs (x7); B, larva (x10); C, pupa (x10); D, adult (x10).

ends of their galleries. Pupation lasts from 7 to 14 days, and in another 2 weeks the new adults are ready to emerge.

The fir engraver is generally considered to have one generation each year, although there are variations at the extremes of its range. There is one complete generation

and a partial second generation each year in the warmer locations. At 6,000 to 8,000 feet elevation in the Sierra Nevada, 2 years are required for a complete life cycle.

Natural Control

Several insect parasites and predators are commonly associated with the fir engraver and occasionally destroy a large part of the brood. The more important predators include two clerid beetles. The black-bellied clerid, *Enoclerus lecontei* Wolc., and the red-bellied clerid, *E. sphegeus* (Fabr.), both prey on engraver larvae and adults. Two braconid wasps, *Coeloides scolyti* Cush. and *C. brunneri* Vier., are parasitic on fir engraver larvae. Females of these wasps insert their ovipositors through the bark and lay their eggs directly on the developing larvae. A mite, *Pediculoides ventricosus* Newport, is also an important parasite on all stages of the fir engraver.

These and other natural enemies may help to control the engraver in some years, but they are not effective in preventing outbreaks.

Applied Control

So far, no satisfactory control measures have been devised for reducing fir engraver populations over wide forested areas. Broods in individual trees can be killed by any one of four standard treatments. When weather conditions permit, the infested tree can be felled and the bark burned in place or peeled and burned to kill the beetles. Another method is to fell the tree in the open, limb the tree, and allow the sun's heat to kill the beetles. Submerging the tree or log in water for a minimum of 6 weeks will also kill the beetles. Finally, penetrating oil sprays of



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Figure 5.—Egg and larval galleries 30 days after attack. Larvae of varying ages are represented by mines of different lengths. (Arrow indicates nuptial chamber.)

ethylene dibromide, which have also been effective against other bark beetles, will kill fir engravers.

None of these methods, however, is economic for engraver control on large areas. The primary difficulty in controlling an infestation over an extensive area is the fir engraver's habit of infesting tops and scattered patches of cambium without killing the trees outright. Elimination of all infested material is the only hope for successful control. It is not practical, however, to

search out and remove the many trees in an infested stand that might contain only a few active broods. Also, if left alone, such trees often recover completely. Consequently, direct control of the fir engraver is usually not advised.

Where possible, windthrown trees and cut logs should be removed from the woods within a year, before the beetles have time to produce new broods. Thus far, forest management practices designed to remove susceptible trees

before they are attacked have not been developed. No method has been found for recognizing susceptible trees before they become infested. Control of defoliating insects, thinning, removal of decadent trees, and other silvicultural practices aimed at maintaining healthy stand conditions appear to offer the best chance for minimizing engraver-caused losses.

CAUTION: Any ethylene dibromide spray spilled on the skin should be washed off immediately with soap and water. Inhalation of the fumes of ethylene dibromide should be avoided.

Reference

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George R. Struble. U. S. Dept. Agr.
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